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Hematological Responses Of Replacement Levels Of Cassava Peels And Maize As Energy Sources In Broiler Diets.

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Abstract: *The haematological response of broilers to replacement levels of cassava peel (CSP) and maize (M) was investigated. The formulated experimental diets: T_1 (0% CSP + 100% M), T_2 (50% CSP + 50% M), T_3 (25% CSP + 75% M) and T_4 (75% CSP + 25% M) respectively, were used in a completely randomized design (CRD). On the last day of a 63-day feeding and growth trial, a set of 2 ml blood samples were taken from 3 broilers per treatment into plastic tubes containing the anti-coagulant ethylene diamine tetraacetic acid (EDTA) for the determination of haematological parameters: PCV, Hb, RBC and WBC. The MCHC, MCH and MCV were also determined. Results on the blood parameters of broilers fed the experimental diets showed normal range of blood values: PVC- 26.00 – 32%; Hb – 8.34 – 10.62 g/dl; RBC – 2.82 – 3.50 $x10^6/mm^3$; WBC - 19.09 - 22.80 $x10^3/mm^3$; MCV -112.12 - 128.70 fl; MCHC - 32.29 - 34.54% and MCH - 38.44 - 43.04 pg recommended for healthy birds. Therefore cassava peel replacement at varying levels with maize as prescribed in this study can serve as an alternative energy source in broiler feed, without any adverse effects on the hematological responses of broilers.*

Key Words*: Hematology, Cassava peel, Maize, Replacement, Broiler.*

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I. Introduction

Cassava (*Manihot esculenta*) represents a significant human food resource and, in many regions, an underutilized animal feed ingredient on a worldwide scale. It has been extensively cultivated as an annual crop in tropical and subtropical regions for its edible underground tuberous root, acknowledged as one of the highest yielders of starch and the third largest source of food carbohydrates in the tropics, following rice and maize [1]. For instance, cassava has been described as a major staple food in the developing world, providing a basic diet for over 800 million people [2].

In recent years, the African continent produced approximately 60% of the global cassava crop (256 million tonne) through targeted efforts to develop improved varieties and only a small fraction is utilized for animal feeding programs throughout Africa [1]. The potential for increased utilization of cassava is enormous, particularly of unused or underused fractions and residues such as peels. Cassava peel fractions represent primary energy sources in feeding programs and its potential as a by-product feed ingredient in Nigeria alone has been estimated at 10% of production with a total of 5.2 million tonne per annum [3].

Various studies [4, 5, 6] has documented the substitution of maize with cassava root/ peels in poultry diets. Consequently, [1] documented the replacement value of processed cassava root/ peels as an energy ingredient when substituting for maize at up to 10 to 40% in various poultry diets. Similarly, cassava peels has been revealed to be a viable ingredient at up to 15% inclusion in diets fed to broilers [5] with a variety of locally available protein sources (i.e. groundnut cake, cashew nut meal, palm oil and methionine) utilized to meet amino acid requirements [7,5].

Hematological responses are good indicators of the physiological status [8] and acts as a pathological reflector of the status of exposed animals to toxicant and other conditions [9], hence animals with good blood composition are likely to show good performance [10] as well as provides a good nutritional assessments of diets [11]. This study therefore investigated the hematological responses of replacement levels of cassava peel meal and maize as energy sources in broiler diets after eight (8) weeks of a feeding and growth trial.

II. Materials And Methods

Site of the Study

The preliminary feeding and growth trial was carried out at the Teaching and Research Farm, Ignatius Ajuru University of Education, Ndele Campus, Rivers State (Latitude 40 58' N and Longitude 60 48' E), Nigeria [12].

Processing of cassava peels for inclusion in composite broiler diets

The cassava peels where obtained within Ndele Community and the campus of Ignatius Ajuru University of Education. They were placed on the floor and sun dried for approximately two weeks. Drying was carried out in order for the peels to be crispy and shredded for ease of transportation, removal of moisture, prevention of fungal growth and easy milling. The shredded cassava peel (CSP) was ground with a generator grinding machine. Other feed ingredients including maize (M), groundnut cake, palm kernel cake, palm oil, soya bean-meal, wheat bran, bone meal, lime stone, lysine, methionine, salt, mineral and vitamin premix were added at various proportions to form the composite broiler starter diets (Table 1) and finisher diets (Table 2) respectively.

Blood sample collection and analysis

On the last day of a 56-day (8weeks) experimental feeding and growth trial, 3 birds were decapitated per dietary treatment making a total of twelve (12) samples for haematological analysis.

The blood samples were collected from each bird. About 2.0 ml bloods were collected into labeled plastic tubes (indicating the treatment and replicates) containing Ethylene- Diamine-Tetra-Acetic acid (EDTA) as anticoagulant.

Hematological response of broilers via values of the blood samples were estimated for packed cell volume (PCV) and hemoglobin (Hb) concentration. Red blood cell (RBC) and total white blood cell (WBC) as well as the differential WBC counts were determined using the Neuberger haemocytometer after appropriate dilution [13]. Values for the constants: mean corpuscular hemoglobin (MCHC), mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV) were calculated from RBC, Hb and PCV values: where, MCV = [(PCV ÷ RBC) X10]; MCHC = [(Hb ÷ PCV) X100] and MCH = [(Hb ÷ RBC) x10] [14].

Statistical analysis

Analysis of variance (ANOVA) using general linear model (GLM) procedures [15] for Complete Randomized Design (CRD) was used to determine the treatment effects of hematological responses among the birds. Treatment means were separated using Duncan Multiple Range Test [16].

Table 1: Formulation of Experimental broiler starter diet

Feed Ingredients	**Treatments**			
	T_1 (0%CSP+100 %M)	**T_3 (50% CSP + 50%M)**	**T_2 (25% CSP+ 75%M)**	**T_4 (75%CSP+25% M)**
Groundnut Cake	15.00	15.00	15.00	15.00
Maize	**50.00**	**25.00**	**37.50**	**12.50**
Palm Kernel Cake	12.00	12.00	12.00	12.00
Palm Oil	1.00	1.00	1.00	1.00
Soya bean Meal	15.00	15.00	15.00	15.00
Wheat Bran	2.00	2.00	2.00	2.00
Cassava peel	**0.00**	**25.00**	**12.50**	**37.50**
Bone Meal	3.00	3.00	3.00	3.00
Lime stone	1.00	1.00	1.00	1.00
Lysine	0.10	0.10	0.10	0.10
Methionine	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Mineral/Vitamin premix	0.30	0.30	0.30	0.30
Total	**100.00kg**	**100.00kg**	**100.00kg**	**100.00kg**

Premix contained the following: (Univit 15 Roche) 1500 I.U, Vit A: 1500 I.U, Vit D: 3000 I.U, Vit E: 3.0g, Vit K: 0.3g, Vit B2: 8.0g, Vit B6: 0.3g, Vit B12: 3.0g, Nicotinic Acid: 5.0g, Ca-Pantothenate: 10.00g, Fe: 0.2g, AL: 3.5g, Cu: 0.15g, Zn: 0.02g, I: 0.01g, Co: 0.01g Se.

Table 2: Formulation of Experimental broiler finisher diets

Feed Ingredients	**Treatments**			
	T_1 (0%CSP+ 100%M)	**T_3 (50%CSP+50%M)**	**T_2 (25%CSP+75%M)**	**T_4 (75%CSP+25%M)**
Groundnut Cake	20.00	20.00	20.00	20.00
Maize	**40.00**	**20.00**	**30.00**	**10.00**
Palm Kernel Cake	15.00	15.00	15.00	15.00
Palm Oil	2.00	2.00	2.00	2.00
Soya bean Meal	15.00	15.00	15.00	15.00
Wheat Bran	2.00	2.00	2.00	2.00
Cassava peel Meal	**0.00**	**20.00**	**10.00**	**30.00**
Bone Meal	4.00	4.00	4.00	4.00
Lime stone	1.00	1.00	1.00	1.00
Lysine	0.10	0.10	0.10	0.10
Methionine	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Mineral/Vitamin premix	0.30	0.30	0.30	0.30
Total	**100.00kg**	**100.00kg**	**100.00kg**	**100.00kg**

Premix contained the following: (Univit 15 Roche) 1500 I.U, Vit A: 1500 I.U, Vit D: 3000 I.U, Vit E: 3.0g, Vit K: 0.3g, Vit B2: 8.0g, Vit B6: 0.3g, Vit B12: 3.0g, Nicotinic Acid: 5.0g, Ca-Pantothenate: 10.00g, Fe: 0.2g, AL: 3.5g, Cu: 0.15g, Zn: 0.02g, I: 0.01g, Co: 0.01g Se.

III. Results

The Proximate composition of the cassava peel and maize used for the various experimental diets is presented in Table 3. The proximate composition of broiler starter and finisher diets of cassava peels and maize at various replacement levels is presented in Table 4. Similarly, the hematological responses of broiler birds fed diets of cassava peels and maize at various replacement levels are presented in Table 5. There were significant variations ($P < 0.05$) in the values of packed cell volume (PCV), hemoglobin (Hb), Red blood cell (RBC) and white blood cell (WBC) among the dietary treatments. The Mean corpuscular volume (MCV), Mean corpuscular haemoglobin concentration (MCHC) and Mean corpuscular haemoglobin (MCH) were significantly ($P < 0.05$) different.

Table 3: Proximate composition (g/100gDM) of cassava peels and maize

Parameters	**Cassava peel (CSP)**	**Maize**
DM	93.77	82.54
Ash	11.77	2.55
CP	6.23	5.55
EE	5.10	5.40
CF	14.90	9.25
NFE	62.00	77.25

DM=Dry matter; CP = Crude protein; EE = Ether extract; CF = Crude fibre; NFE = Nitrogen

Table 4: Proximate composition (g/100g Dry matter) of broiler starter and finisher diets of cassava peels and maize at various replacement levels

Parameters	**T_1(0% CSP+100%M)**	**T_2 (50%CSP+50%M)**	**T_3 (25%CSP+ 75%M)**	**T_4 (75% CSP+25%M)**
Broiler Starter Diets				
Crude protein (CP)	17.5	20.12	16.75	18.37
Ash	7.0	7.5	8.5	8.5
Ether extracts (EE)	3.5	3.5	4.0	3.0
Crude fibre (CF)	8.5	11.0	10.5	11.25
Nitrogen free extracts (NFE)	63.5	57.88	60.25	58.88
**ME(kcal/kg DM)	3153.05	3045.24	3052.33	2978.59
Broiler Finishers Diets				
Crude protein (CP)	15.45	18.32	14.75	16.56
Ash	8.0	8.55	10.5	11.00
Ether extracts (EE)	5.00	4.75	4.55	4.05
Crude fibre (CF)	7.5	10.0	9.50	10.25
Nitrogen free extracts (NFE)	64.05	58.38	60.70	58.14
**ME(kcal/kg DM)	3223.51	3102.24	3043.29	2974.86

**ME (kcal/kg) = (35 × % CP) + (81.8 × % EE) + (35.5 × % NFE) [26].

Table 5: Hematological response of broilers fed diets of cassava peels and maize at various replacement levels

Parameters	**T_1 (0% CSP+100%M)**	**T_3 (50%CSP+50%M)**	**T_2 (25% CSP+75%M)**	**T_4 (75% CSP+25%M)**	**SEM**
PCV (%)	31.84^a	32.00^a	29.83^b	26.00^c	1.41
Hb (g/dl)	10.62^a	10.40^a	9.96^b	8.34^c	0.34
RBC ($x10^6/mm^3$)	3.40^b	3.45^a	3.50^a	2.82^b	0.39
WBC ($x10^3/mm^3$)	22.46^a	22.80^a	22.53^a	19.09^b	1.32
MCV (fl)	114.59^d	112.12^c	128.70^a	124.36^b	1.16
MCHC (%)	34.54^a	34.16^{ab}	33.80^b	32.29^c	0.42
MCH (pg)	40.84^b	38.44^c	43.04^a	40.95^b	0.80

^{a,b,c,d} Means bearing different superscripts along the same row are significantly different ($P < 0.05$). SEM = Standard Error of Mean, PCV = Packed Cell Volume, Hb = Haemoglobin, RBC = Red Blood Cell, WBC = White Blood Cell, MCV = Mean cell volume, MCHC = Mean corpuscular haemoglobin concentration, MCH = Mean corpuscular haemoglobin.

IV. Discussions

The CP, CF and ash fractions of the diets increased with the increased replacement of cassava peel with maize while the EE component decreased with decreased replacement of cassava peel with maize. However, the lower metabolic energy (ME) of the starter and finisher broiler diets are related to the higher replacement levels of cassava peels with maize. Consequently the starter and finisher broiler diets with various cassava peel replacement levels with maize as energy feedstuffs are within the recommended 2,800 - 3,200 kcal/kg DM for young and adult broilers [17,18].

The PCV values obtained from this study were within the standard range of 22-35% for healthy chickens [19]. The hemoglobin (Hb) values obtained in this study were also within the normal range for chickens (7-13g/l) [18] and for broilers (8.6 – 10.7g/l) [20]. The PCV and Hb values reported in this study for the experimental diets is very relevant as these hematological indices have been earlier correlated with nutritional status of animals [21]. The Red blood cells (RBCs) value ($2.82 – 3.50 \times 10^3/mm^3$) reported in the study for the broiler chickens were within the normal range ($2.5 – 3.5 \times 10^3/mm^3$) for normal or healthy chickens [18]. This implies that the replacement of broiler feeds at different levels of cassava peels and maize has no deleterious effect on the broilers as they maintain their normal blood count [22].

The MCV values range between 112.12 – 128.70fl for T_2 and T_3 respectively. However the values fell within the values reported for normal broilers by [23]. The MCHC values range between 32.29 - 34.54% reported for broilers by [24]. Similarly, the MCH values range between 38.44 - 43.04 pg and fell with the normal value for broilers reported by [25]. Consequently, the range of normal values obtained in this study are an indication of the quality of the test diets as haematological parameters are a reflection of the animal responsiveness to the diets with varying cassava peel meal replacement with maize.

V. Conclusion

The results of the study indicate that cassava peel replacement at varying levels with maize as prescribed in this study can serve as an alternative energy source in broiler feeds, without any adverse effects on the hematological responses of broilers.

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